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Increasing Department of Surgery Productivity: A Study on the Effects of Adding an Ambulatory Surgery Room to Tripler Army Medical Center

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14. ABSTRACT
In the summer of 2005 the Army Surgeon General challenged medical treatment facilities (MTFs) to increase productivity in terms of relative value units (RVUs). Tripler Army Medical Center submitted 12 initiatives, one of which was the implementation of an ambulatory surgery room within the Department of Surgery. This study examined the structure and processes used to develop this room, and the outcomes of the initiative. Problems contracting for staff to operate the room and scheduling methodology resulted in an inefficient process. Analysis of variance was used to examine differences between the ambulatory surgery room and other rooms for RVU production. 1257 cases during the months of December 2005 and January 2006 were used in the analysis. Results showed there was a statistical significance between the rooms, $F(13,573) = 3.70$, $p<.000$. A post-hoc test revealed the room showing significance was not the ambulatory surgery room. Based on the results it is recommended the hospital look for proven ways to improve productivity before obligating money toward high risk initiatives.

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Abstract

In the summer of 2005 the Army Surgeon General challenged medical treatment facilities (MTFs) to increase their productivity in terms of relative value units (RVUs). MTFs had approximately 10 days to submit initiatives to improve RVUs to the Surgeon General's office for funding. Tripler Army Medical Center submitted 12 initiatives, one of which was the implementation of an ambulatory surgery room within the Department of Surgery. This study examined the structure and processes used to develop this room, as well as outcomes of the initiative. Problems contracting for staff needed to operate the room and scheduling methodology resulted in an inefficient process within the room. Analysis of variance was used to examine significant differences between the ambulatory surgery room and other rooms for RVU production. 1257 cases during the months of December 2005 and January 2006 were used in the analysis. Initial results showed there was a statistical significance between all the rooms, F (13,573) = 3.70, $p<.000$. However, a post-hoc test revealed the room showing significance was not the ambulatory surgery room. Based on these results it is recommended that the hospital look for proven ways to improve productivity before obligating money toward high risk initiatives.

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Introduction

According to the Healthcare Financial Management Association (HFMA, 2002), balancing the rising cost of healthcare, changing reimbursement methodology resulting in lower payouts to providers, increasing uncertainty in the economy, and the increasing demand for healthcare services are the greatest challenges to healthcare leaders. These challenges have resulted in a decade of profit loss and increased demand (HFMA, 2002). Shi and Singh (2004) posit that over the next 25 years the portion of the population age 65 and older is expected to rise from 12 percent to 20 percent. Healthcare costs for the elderly are 3.5 times more expensive than non-elderly, so the demand for healthcare services will continue to rise (Shi & Singh, 2004).

HFMA (2002) suggests one way hospitals can raise their profit margins is by increasing operating room utilization. Operating rooms are the biggest cost centers and revenue producers in the hospital. They account for approximately 42 percent of a hospital's revenue and cost (HFMA, 2002). However, an industry study shows that the average utilization rate of operating rooms is only 68 percent. This causes a problem because while the variable cost (pharmaceuticals and supplies) to operate the operating room may be low, the fixed cost (personnel, equipment, and administration costs) still remains. The result is a higher cost to run the operating room due to the low utilization rates. Increasing utilization is therefore one way to increase the profit margin for the operating room (Driscoll & Meyer, 2004).

Along with increasing the utilization rate, the growth of outpatient surgery and ambulatory surgery centers (ASC) has also helped control costs associated with operating rooms (Federated Ambulatory Surgery Association [FASA], 2005). According to FASA (2005), a procedure performed in an ASC is 47 percent cheaper than the same procedure performed within a hospital. They attribute this result to the lower overhead cost associated with operating the ASC. ASCs also show higher utilization rates. According to a FASA (2005) outcome survey, 75 percent of ASCs start 95 percent of their cases on time. The on-time starts yield more cases per day which lowers the overhead cost per case.

The military healthcare system (MHS) is a not-for-profit system whose past budget development methodology was based on the previous year's spending plus an inflation factor. The recent introduction of the prospective payment system to the MHS refocused the budgeting process by rewarding hospitals that have higher productivity with larger budgets. While it has not been implemented 100 percent, it has pushed hospital productivity to the forefront.

Being a not-for-profit system makes the cost of services in the MHS very relevant. MHS hospital productivity is currently measured in terms of Relative Value Units (RVUs) for outpatient and Relative Weighted Procedures (RWPs) for inpatient procedures. By decreasing the cost per RVU/ RWP, as compared to a civilian healthcare center, a MHS hospital is ultimately saving the government money. In order to accomplish this, the hospital must increase productivity. By increasing productivity the hospital creates a bigger denominator to absorb more of the cost, therefore decreasing the cost per RVU/ RWP. The primary purpose

of this study was to explore the addition of an ambulatory surgical room to increase overall RVU production for the department of surgery. While RVU production was the center of this study, one cannot study operating room productivity without looking at other key variables such as operating room structure, processes, turnover time, and cost. These variables were also assessed during the course of this study.

Conditions that Prompted Study

On 10 July 2005 the Army Surgeon General challenged all Army Medical Treatment Facilities (MTF) to increase their productivity levels in terms of total RVUs/ RWPs for fiscal year (FY) 2006 as compared to FY 2005. MTFs who submitted sound initiatives to increase their RVU or RWP productivity would be funded for these so called "Jump Start Initiatives" for FY 06 implementation. Those hospitals whose initiatives increase RVU/ RWP production will continue to have those initiatives funded for the next fiscal year, while those initiatives that fail will lose funding. Tripler Army Medical Center submitted 12 initiatives that are expected to increase the hospital's total RVUs by approximately 70,000 over the course of FY 06. Tripler received $3.2 million to implement all 12 initiatives. The hospital estimated the initial investment would result in a 30.2 percent return on investment (prospective payment value) in a one year time frame. One of the 12 initiatives sent forward was to increase operating room productivity by hiring six full time equivalents (FTEs) to operate an ambulatory surgical room. This initiative was expected to increase total operating room productivity by 6,000 RVUs, cost $632,000, and have a 4.7 percent return on investment.

Problem Statement

Prior to the Army Surgeon General's 2005 Jump Start Initiatives, MTFs seeking venture capital funds from Medical Command (MEDCOM) to finance new initiatives were forced to perform and submit a lengthy business case analysis on the proposed initiative. While conducting the business case analysis and awaiting MEDCOM approval could take months, the process ensured the proposed initiative was adequately studied at all levels to ensure the money spent would result in a positive investment for the Army Medical Department (AMEDD). Under the Jump Start program, MTFs were given approximately one week to submit proposed initiatives for funding. In some cases the traditional business case analysis was not performed. Initiatives were proposed and in some cases funded with little or no knowledge as to whether they would accomplish the proposed intent. The Tripler ambulatory surgery initiative is one of those initiatives. The problem lies in the fact that while the Army Surgeon General has made it easier for hospitals to receive venture capital funds, it appears Tripler has proposed and been funded for initiatives with little or no research on their feasibility.

Literature Review

Introduction

This literature review aims to examine several issues pertinent to evaluating productivity within an operating room. With the quality of healthcare in the United States under scrutiny, as evident by the Institute of Medicine (2001)

report entitled Crossing the Quality Chasm, a review of how quality and productivity are related is conducted. Since RVUs are the center of this study, the history and development of the RVU, its effect on healthcare financing, and eventual adoption by the MHS as a measure of productivity is reviewed. Furthermore this review looks at the move from inpatient to outpatient care and the subsequent development of outpatient surgery. Lastly, it looks at some case studies performed on increasing operating room productivity and presents two models for assessing outcomes.

Healthcare Quality and Productivity

The quality of healthcare service within the United States has been pushed to the forefront of the healthcare industry due to several Institute of Medicine reports. Joshi, Nash, and Ransom (2005) suggest that quality is measured in many different ways depending on the perspective from which it is viewed. Patients, providers, payers, and society all define quality from their own viewpoint. Patients tend to view quality in terms of access to care, interpersonal skills of providers, and the extent to which their preferences are taken into account. Providers view quality in terms of technical performance. Payers, who are comprised of insurance companies and other third-party payers, assess quality in terms of cost. Similarly society looks at quality in terms of cost effectiveness, because it is their taxes which fund government healthcare programs (Joshi, Nash, & Ransom, 2005). Over the past few years the RVU has become the leading measure of productivity and cost effectiveness within the healthcare industry. Robbins (2003) suggests an organization is productive when

it achieves its goals, and does it at the lowest cost. Therefore by definition productivity includes measures of both effectiveness and efficiency, where effectiveness is a measure of whether an organization achieved it goals and efficiency is the ratio of inputs to outputs in terms of cost. Subsequently RVUs, a measure of productivity, have become synonymous with quality from a business perspective.

RVU Development

In 1989 Congress created the Physician Repayment Review Commission (PRRC), with a mission of determining how to reform physician Medicare repayment (McMahon, 1990). During the committee's second year of service it recommended a resource-based fee schedule. Based on these findings the Centers for Medicare and Medicaid Services (CMS), formerly known as the Healthcare Financing Administration, contracted with the Harvard School of Public Health and the American Medical Association (AMA) to build a resource-based relative value system.

The development of the system consisted of a panel of physicians selecting cases (vignettes) easily recognizable by a majority of practicing physicians (McMahon, 1990). These cases also corresponded to commonly used Current Procedural Terminology (CPT) codes. Of the over 7,000 CPT codes, 373 were chosen to be included in a national survey of 3,164 physicians. The survey was administered in 1986. The physicians were asked to estimate the amount of work necessary for each of the vignettes identified by the panel. Survey results were evaluated and used to develop the work component of the Resource Based

Relative Value Scale (RBRVS). Furthermore, the results were extrapolated to develop the similar component for those CPT codes that were not surveyed. Lastly, practice costs and opportunity costs were taken into account for each CPT. The results of the study were deemed the RBRVS (McMahon, 1990).

According to Becker, Braun, Dunn, and Hsiao (1988) the RBRVS is perceived by lawmakers as a tool to adequately reimburse physicians for their services. Becker, Braun, Dunn, and Hsiao (1990) conducted further analysis on Harvard Resource Based Relative Value Scale. Based on their research the scale provides a rational and systematic way of defining and measuring physician services. The authors suggest that this scale could be the basis for a national payment policy and fee schedule. Furthermore they suggest that if enacted the fee schedule could help identify and possibly eliminate overcharging for physician services. Becker, Braun, Causino, Dunn, Hsiao, McCabe, et al. (1992) published the results of their study on the impact of RBRVS, which was the basis for the Medicare Fee Schedule enacted in 1989. Based on their research, if the fee schedule was fully implemented, Medicare income for family practitioners would increase by 30 percent while it would decrease for most surgical subspecialties by 10 – 20 percent.

Out of the RBRVS came the RVU (Hamilton, 2004). RVUs are made up of three common components. The physician work component, centered on pre-service, intra-service, and post-service work, makes up about 52 percent of the total (McMahon, 1990). It is based on the time it takes a physician to perform the given service, as well as the technical skill and physical effort. This value is

consistent for all physicians. The practice expense component accounts for about 44 percent of the total. It is based on the resources consumed and geographic location of the service. Each geographic location is given regional conversion factors (CFs) by Centers for Medicare and Medicaid Services to establish a dollar value and to account for differences in the standard of living for various regions. The CFs are updated annually and must be completely reviewed every five years for accuracy. For example, a routine physical may get an RVU value of 2.0. This would be multiplied by a conversion factor of $5 for a given geographic area to establish a reimbursable value of $10 for each physical provided. A physician in another region will also have an RVU value of 2.0 for a routine physical but may have a CF of $10 based on location. This would yield a reimbursable value of $20 for each physical. The last component of the RVU is the professional liability insurance. Insurance accounts for four percent of the total and is based on the cost of medical liability insurance in that specific geographic area. An example of some common RVUs and how they break down by the three common components are listed in Table 1. Reimbursement based on RVUs prevents two physicians practicing in the same location from receiving different reimbursements for the same procedure (Hamilton, 2004). This ultimately helps keep the cost of services to the consumer lower.

Table 1

2001 RVUs for Common Physician Services

Service	CPT Code	Physician Work	Physician Expense	Insurance	RVU
Office Visit, Detailed, Established Patient	99213	.67	.62	.03	1.32
Office Visit, Complex Established Patient	99215	1.77	1.22	.07	3.06
Office Visit, Detailed New Patient	99203	1.34	.97	.08	2.39
Cardiac Catheter – left side only	93510	4.33	38.54	2.13	45.0

Note. From "Resource-Based Relative Value Units: A Primer For Academic Family Physicians," by Johnson, S.E. & Newton, W.P., 2002, Family Medicine, 34(3), p. 173.

By understanding these factors organizations should be able to determine the organization's cost per RVU at every level within the organization. The cost per RVU will differ from location to location based on the cost of running the organization. To figure the cost per RVU an organization needs to know the total cost of running the organization and the amount of RVUs produced annually. The cost is then divided by the total RVUs produced to determine the organization's cost per RVU (Hamilton, 2004). The cost per RVU can then be refigured at various levels throughout the organization. With these analyses, the organization can compare the cost of production versus the amount of reimbursement. Healthcare executives can look at the return on investment, RVU generating

capacity, and cost per RVU versus reimbursement per RVU before determining to add or drop a service. RVUs have become very important within the MHS recently. Hospital commanders are being forced to look at what it costs to produce services in their hospitals and look for ways to lower the cost per RVU compared to that of similar care received outside of the hospital.

Section 12111 of the Omnibus Budget Reconciliation Act of 1990 tasked the Secretary of Health and Human Services with developing a proposal to replace the way repayment was made for hospital outpatient services. The act mandated the new system's payment methodology be based on prospectively determined rates (U.S. House of Representatives, 1990). The Omnibus task was followed seven years later by an implementation task within the Balanced Budget Act of 1997. In the Act, the Secretary of Health and Human Services was tasked with the implementation of a prospective payment system for Medicare outpatient services (CMS, 2004). Based on the Act, a fee schedule was developed for repayment of outpatient physician services using claims data from 1996 (U.S. House of Representatives, 1997). Furthermore the fee schedule took into account labor costs and geographic location very similar to the development of the RBRVS. The resulting prospective payment system for outpatient services was implemented in January 2000 (Centers for Disease Control, 2004).

Since the implementation of legislation using prospective payment the RBRVS has become the main model used today to quantify, describe and reimburse physician services (Johnson & Newton, 2002). At all levels of the United States healthcare system, the RBRVS is used to determine payments for

services. Furthermore at the institutional level healthcare executives are using RVUs to trace physician productivity and evaluate job performance. Thus the RVU has begun to influence the daily practice of many physicians and the policies that shape the healthcare market (Johnson & Newton, 2002).

MHS Adoption of the RVU/ RWP

In June 2004 the prospective payment system was implemented within the MHS (Winkenwerder, 2004). Under Health Affairs Policy 04-014 the Assistant Secretary of Defense for Health Affairs states the prospective payment system is being implemented to transform the MHS and to support the President's Management Agenda, which requires performance-based budgeting (Winkenwerder, 2004). An individual RVU/ RWP has an associated prospective payment rate associated with it. For example the average rate per RVU is $74 (Opsut, 2004). The idea behind the prospective payment system is that hospitals will be funded based on their output. Output is measured in terms of RVUs and RWPs (Opsut, 2004).

Move to Outpatient Care

The consumer price index (CPI) of all medical care has risen 353.4 percent between 1980 and July 2005, which is 2.3 times more than the CPI for all items within the United States (Bureau of Labor and Statistics, 2005). Grant (1992) suggests the 135 percent rise in the cost of inpatient hospital care during the decade between 1981 and 1991 was a factor leading to the shift from inpatient to outpatient care. Insurance companies also responded to the

increasing cost by offering incentives for customers who used outpatient services. By covering a higher percentage of the cost when patients chose an outpatient setting, insurance companies helped shape the change in consumer thinking and ultimately saved the consumer money (Grant, 1992).

Following the move from inpatient to outpatient care, the major trend in surgery during the 1980s and 1990s was a shift towards outpatient surgery with a decrease in the rate of inpatient surgery (Kozack, McCarthy, & Pokras, 1999). Ambulatory surgery has grown from approximately three million surgeries in 1980 to 27 million in 1995. Simultaneously inpatient surgery declined by 14 percent. Two factors have been used to explain this pattern. Advances in surgical techniques made surgery easier on patients and thus increased the demand for this type of care. Policies creating economic incentives stimulated a growth in ambulatory procedures and settings (Kozack, McCarthy, & Pokras, 1999). Six years after the initial explosion of outpatient surgery the numbers of outpatient surgery centers continues to rise. The CMS identified an eight percent increase in outpatient surgery centers between 2000 and 2001 (Andrews, 2003).

Improvements in drugs and procedures have lessened post-operative recovery time. Less invasive procedures, such as laser surgery, laparoscopy, arthroscopy, and endoscopy have reduced surgical trauma (Kozack, McCarthy, & Pokras, 1999). These procedures coupled with advances in medical equipment have allowed patients to return to their normal daily activities sooner (Andrews, 2003). Advances in medical technology have allowed certain procedures to be performed in the physician's office. One specialty that has benefited a great deal

is Ophthalmology. The rate of inpatient eye surgery has decreased from 14.1 per 10,000 to 4.5 per 10,000 between 1990 and 1998 (CDC, 2004). These advances have also changed the risk-benefit ratio for many patients. Patients who have minor or nagging symptoms are now more likely to seriously consider surgery to alleviate the condition. Furthermore patients who were once considered too high risk to undergo certain procedures are now primary candidates with less invasive techniques. The end result of the movement to more outpatient surgery is a greater demand and a larger pool of potential surgical patients (Kozack, McCarthy, & Pokras, 1999).

Operating Room Productivity

Because RVUs have become the standard for measuring productivity in the healthcare system, any hospital attempting to achieve superior productivity must analyze, develop, and implement realistic standards by which to measure (Fogel, 2002). According to Fogel (2002) the first step in a productivity analysis is to review the designated department's past performance data and place the department into one of four groups. A department is either losing ground, holding steady, gaining, or a new program. Fogel (2002) goes on to suggest that no matter what type of productivity analysis or productivity initiative a hospital employs there will undoubtedly be objection from the department leadership. It is the hospital's senior leadership responsibility to empower the managers and ensure they understand the purpose behind any new initiative. Furthermore in order for any analysis or initiative to be effective, there must be buy-in from all levels within the respective department.

Brenn, Cook, Deutsch, Hetrick, and Reilly (2003) conducted a study in which a hospital set up two different operating rooms. One room was staffed the standard way with two staff, a scrub nurse, and circulator. The other room, named the "short procedure room," was staffed with just a circulator, thereby eliminating staff and reducing labor cost. Within the two rooms three different types of otolaryngology procedures were performed by three different physicians. The results of the study showed that two of the three procedures as well as all of the physicians showed a statistically significant ($p<.01$) decrease in total operating time in the short procedure room. The third procedure also showed a decrease, but not of statistical significance. Another area of note was in turnover time. The short procedure room was turned over in an average of 12 minutes compared to 17 in the normal room (Brenn, Cook, Deutsch, Hetrick, & Reilly, 2003).

According to HFMA (2002), the streamlining of workflow within the operating room is one way to improve productivity. On-time starts and turnover time represent two areas that will benefit the most from streamlining. Hospitals average 27 percent on-time starts. This results in cases scheduled late in the day becoming backlogged or delayed. By adequately addressing the entire workflow process operating room personnel can increase revenue (another word for RVUs), and decrease cost. By scheduling and completing one additional case a day, a hospital can generate up to $1.8 million dollars in revenue over the course of a year (HFMA, 2002).

One method used to improve on-time starts is to focus on the scheduling methodology. Lebowitz (2003) used a Monte Carlo Simulation to develop a model operating room suite. Each model performed surgeries on a combination of short procedures (60 minutes in length +/- 15 minutes) or long procedures (140 minutes +/- 45 minutes). A typical day was 510 minutes or 7:00AM to 3:00PM. The model produced six different operating room schedules. Four of the rooms saw a mixture of short and long procedures, while one room saw only short and the other only long procedures. The results of the study showed that those rooms that had short procedures scheduled first completed over 90 percent of the day's scheduled procedures. The room that performed only short procedures completed 100 percent of its scheduled cases. Those rooms which performed long procedures first completed less than 60 percent of the room's scheduled cases. Furthermore those rooms scheduling short procedures first had a wait time between cases that was two times less than that of rooms doing long procedures first.

In March of 2005 Brooke Army Medical Center, located in San Antonio, Texas, established an orthopedic only operating room suite to deal with a backlog of patients awaiting orthopedic surgery (T. Kaiser, personal communication, August 24, 2005). Many of the patients were soldiers from the Global War on Terrorism. The room was staffed with four contract personnel who worked only in the orthopedic suite. According to Kaiser (2005) the physicians liked the setup because they knew exactly who their assistants would be each day. In its first 21 week history this set-up completed 362 cases, had a utilization

rate of 90 percent, and an average turnaround time of just over 20 minutes (L.W. Peralta, personal communication, August 19, 2005). Most noteworthy is its decrease in average wait time for certain procedures from approximately four months to around 30 days. According to Kaiser (2005) the biggest issue that needed to be addressed with the initiative was buy-in from the permanent staff.

Outcome Evaluation

Throughout the literature a number of authors have proposed several models for the evaluation of healthcare. Usually these models are said to be evaluating the quality of healthcare. One of the more prominent models was proposed by Avedis Donabedian in 1966 and again in 1988. The conceptual model consisted of three dimensions: structure, process, and outcome (Donabedian, 1988). Structure relates to static characteristics such as facilities, equipment, and personnel (Joshi, Nash, & Ransom, 2005). Process looks at what takes place during care, while outcomes assess the effect on care in regards to a patient's health. Donabedian (1988) suggests that each dimension can be judged independently or in conjunction. Furthermore he says if both structure and process are adequate, one can assume the outcome will be positive.

Starfield (1973) adjusted Donabedian's (1966) model to take into account the effects of social and physical environment on structure, process and outcomes (Figure 1). She suggests that the process dimension is independent of the outcome. Therefore process is a better measure of quality because a negative outcome does not always occur when there is an error in the process.

For this reason Starfield writes outcomes should not be the only criterion for assessing quality healthcare services (Starfield, 1973). A query of Ovid, an on-line service used to search for published articles on a variety of topics, shows 182 articles citing the Donabedian 1966 article "Evaluating the Quality of Healthcare," 199 articles citing the Donabedian 1988 article "The Quality of Care: How Can it be Assessed?," and seven articles citing the Starfield 1973 article "Health Service Research: A working model." It is the author's belief that the overwhelming use of both the Donabedian and Starfield articles shows this model to be the most valid model in use today for measuring outcomes of organizations in the healthcare business.

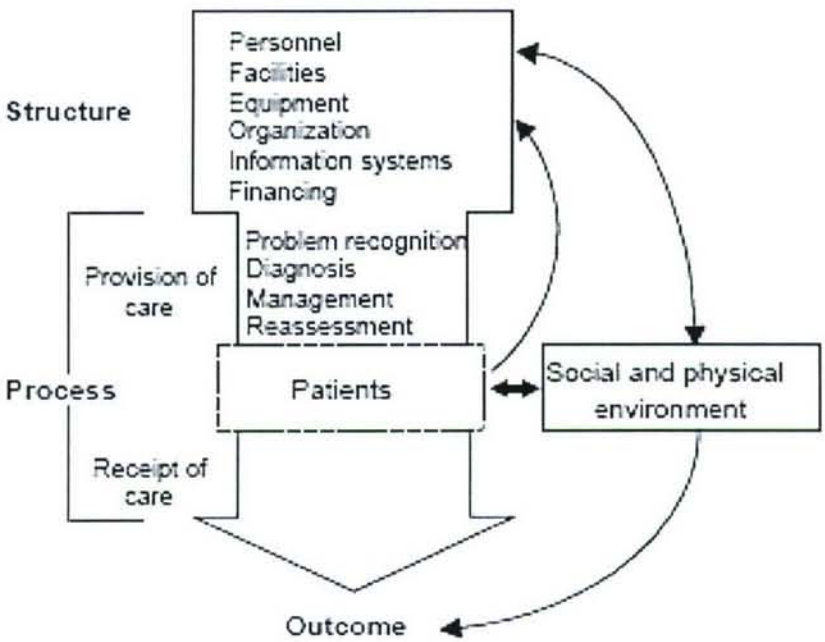

Figure 1. Starfield Structure, Process, Outcome Model

From "Health Service Research: A Working Model," by B. Starfield (1973), *New England Journal of Medicine*, 289, 132-136.

Aday, Begley, Lairson, Montoya, Richard, & Slater (1999) proposed a way to further examine the outcome piece of Donabedian's structure, process, and outcome model. Aday, et al. (1999) proposed that the delivery of healthcare is ultimately designed to improve the health of individuals and communities. The authors go on to explain that this endeavor is an ongoing process which can be best evaluated using measures of effectiveness, efficiency, and equity (Figure 2). Each of these measures is further broken down into two categories. Effectiveness is listed above efficiency and equity signifying its overall importance within the model.

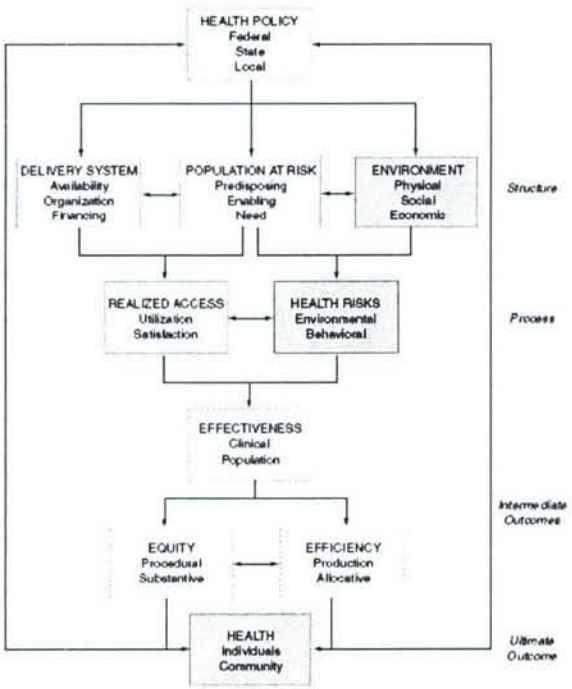

Figure 2. Effectiveness, Efficiency, Equity Model

From "A framework for assessing the effectiveness, efficiency, and equity of behavioral healthcare," by Aday, et al, *The American Journal of Managed Care*, 5, SP25-SP44.

The framework proposed by Aday, et al. (1999) defines effectiveness from two different viewpoints. A macro level analysis looks at the population effectiveness of a system, whereas a micro level analysis looks at the clinical effectiveness of a system. A population approach looks at the effect of the care provided at a community level in terms of care received. Clinical effectiveness is judged at the system or institutional level. It seeks to address the outcome that results from the interaction between the physician and the patient.

Efficiency is defined as obtaining the greatest amount of goods and services which will yield the greatest value while limiting cost (Aday, et al, 1999). Efficiency is further subdivided into allocative and production efficiency. Allocative efficiency looks at allocating the appropriate amount of inputs to achieve the desired outcome. Production efficiency is a measure of cost. It addresses whether the desired outcomes were produced at the most cost-effective method. This assessment is usually performed through a cost-benefit, cost-effectiveness, or cost-utility analyses.

The equality measure looks at the extent to which disparities or inequities occur and are minimized among the population (Aday, et al, 1999). Like the other two measures, equality is subdivided into substantive and procedural equity. Substantive equity refers to the minimization of disparity in health among groups within the population. Procedural equity looks at the extent to which the processes put in place to achieve the desired outcomes is judged to be fair.

Conclusion

This review has looked at the relationship between quality and productivity, the development of the RVU and its effect on financing, the MHS's move to prospective payment and the RVU, and the move to outpatient care and surgery. Lastly it presented operating room productivity case studies and models by which to evaluate outcomes. Based on the literature this author has concluded any new hospital initiative must have buy-in from all employees involved in order to be successful. Furthermore, when it comes to improving operating room productivity, the ability to appropriately schedule cases can result in more on-time starts a higher utilization rate, lower cost, and increased revenue.

Methodology

Setting/ Purpose

The study originates at Tripler Army Medical Center, located in the state of Hawaii on the island of Oahu. This descriptive study was designed to evaluate outcomes for the Tripler Department of Surgery before and after the implementation of the ambulatory surgery room using the structure, process, and outcome (effectiveness, efficiency, equity) model (Figure 3). The evaluation was designed to answer the question whether the utilization of an ambulatory surgery room would produce significantly more RVUs than a room operating under normal conditions. For the purposes of this study, the analysis looked at only those operations that took place with in the walls of the 12 room operating suite. RVUs produced in any of the surgical subspecialty clinics were not evaluated because the jumpstart initiative only accounted for operating rooms. For the

purposes of cost data, Medical Expense and Performance Reporting System (MEPRS) code DFBA (TAMC Operating Suite) was used to accurately assess the costs associated with the operating room suite.

MEPRS is a cost management system that accumulates and reports workload, expense, and manpower performed by Department of Defense fixed medical treatment facilities (Army MEPRS Program Office, 2005). MEPRS provides the Department of Defense with a consistent reporting tool for all MTFs. The data obtained from MEPRS provides healthcare executives with the necessary financial and productivity data to make informed decisions.

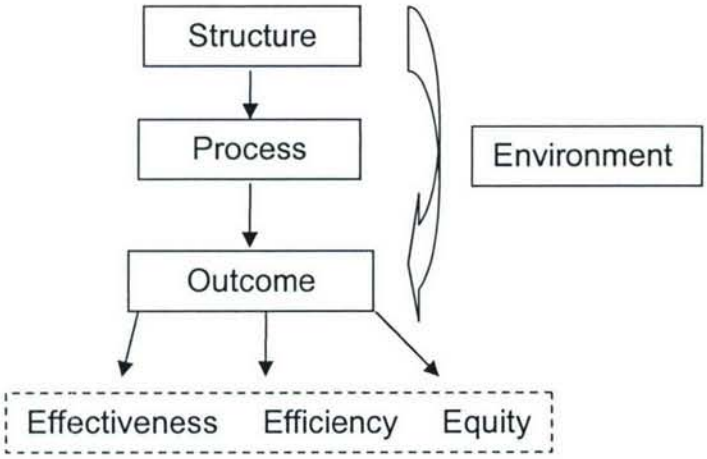

Figure 3. Outpatient Surgical Room Research Model

The initiation of the ambulatory surgical room changed the existing structure by opening the twelfth operating room and added six FTEs worth of staff (2- Operating Room Nurses, 2-Operating Room Technicians, 1-Certified Registered Nurse Anesthetist, and 1-Central Material Services Technician). The new staff operated the additional operating room focusing on outpatient procedures. The staff was solely responsible for providing the entire scope of pre-operative evaluation, screening, patient teaching, intra-operative monitoring,

documentation, surgical assistance, post-operative monitoring, and review of post-operative patient instructions for home care and follow up.

Analysis Framework

The implementation of the ambulatory surgical room was analyzed using the structure, process, and outcome model. The outcomes were further analyzed using the effectiveness, efficiency, and equity model, also known as the three E analyses as seen in Figure 3. By using this type of analysis, the ambulatory surgical room initiative was analyzed at several levels. See Table 2 for the variables associated with each aspect of the model and their data sources.

The structure element was defined as the resources (personnel and equipment) used within the operating room. Examination of this element seeks to explain any major changes in resources used before and after the implementation of the initiative. The process element was examined by looking at the step by step approach in implementing the initiative. The scheduling methodology was also analyzed to see what process optimized the initiative. Finally the turnover time will be measured and compared to the rest of the operating room.

Turnover time for each operating room was computed by the Surgery Scheduler System. The operating room nurse and anesthesia provider manually fill out the procedure "buck slip" (see Appendix A for an example) with designated times. Some of the times include Nursing Start, In Room, Anesthesia Start, Turned over to Surgeon (TOTs), Cut, Close, Anesthesia End, Out of Room, Nursing End. The data is manually transmitted from the buck slip into the Surgery

Scheduler System by a nurse who may or may not have been in the operating room for the specific surgery. The scheduler system uses the time "out of room" and time "in room" to automatically compute the turnover time for each respective operating room.

Using the model, the effectiveness variable was examined from the clinical and population perspective. The clinical perspective looked at the raw RVU totals before and after the implementation. This was the most important part of the study as an increase in RVUs (productivity) was the goal of the initiative. The population perspective looked at the effects the initiative had on the patient population. The measures of the population perspective were the size of the operating room waiting list per month.

The efficiency variable was analyzed using the production perspective. Keeping RVUs as the centerpiece of this study, a measure of cost per RVU for the Department of Surgery was used. A sensitivity analysis was completed to determine the sensitivity of RVUs to cost. Furthermore, return on investment (ROI) for the initiative was calculated as a measure of production efficiency.

The equity variable was analyzed using the procedural equity perspective. Procedural equity looks at whether the process put in place was fair. It was measured by looking at the patients who were scheduled for surgery in the ambulatory surgical room and determining if they were on a waitlist and, if so, how long. The goal was to determine whether patient selection was based on the number of RVUs that could be obtained for certain cases over others.

Table 2

Study Model and Variables

Model		Variable	Data Source	Measurement
Structure		Equipment	Operating Room Chief Nurse	EQ*
		Personnel	Operating Room Chief Nurse	PQ*
Process		Turnaround Time	S3	Computed by S3
		Scheduling	Operating Room Chief Nurse	SQ*
Outcome	Effectiveness	RVUs	PASBA RVU TABLE 2005	Procedure CPT codes will be cross referenced with an RVU table.
		Waitlist	S3	# of personnel on the waitlist before and after implementation.
	Efficiency	Cost per RVU	M2	OR TC* / Total RVUs
		Return on Investment	M2	Initiative TC / (Total RVUs*PPS Value)
	Equity	Waitlist Wait Time	Operating Room Chief Nurse	WQ*

Note.

EQ – Equipment Questions
PQ – Personnel Questions
SQ – Scheduling Questions
TC – Total Cost
WQ – Waitlist Questions
PASBA – Patient Administration Systems and Biostatistics Activity

Variable Definition

The following variables were used in the analysis of the out patient surgery room initiative.

- Dependent Variables: The dependent variables for the statistical portion of this study were as follows.
  - RVU: The RVU variable was used to compare rooms and services on productivity output.
  - Turnover Time: Turnover time was the dependent variable for assessing rooms versus turnover time.
- Independent Variables: The independent variables for the statistical portion of this study were as follows.
  - Room: was defined as the operating room that the surgery took place in.
  - Service: was defined as the sub-specialty service performing the surgery.
- Equipment: Defined as any new durable equipment in excess of $5,000 bought to execute the ambulatory surgery room initiative. In order to establish a reliable method for collecting this data, the operating suite Chief Nurse was asked the same two questions at the end of each month. The questions were as follows: 1) Was any new equipment in excess of $5,000 purchased for the ambulatory surgery initiative? 2) Do you perceive the need to purchase any equipment in excess of $5,000 for the

ambulatory surgery room next month? For the purpose of this study, these questions were called "Equipment Questions" (EQ).

- Personnel: Defined as any new personnel hired to facilitate the operation of the ambulatory surgery room. As with the equipment variable, the operating suite Chief Nurse was asked two questions with regards to personnel. These questions were called "Personnel Questions" (PQ). The questions were asked at the end of each month and are as follows: 1) Have you hired any new staff members to facilitate the ambulatory surgery room initiative? 2) Do you perceive the need to hire any additional staff to facilitate the ambulatory surgery room initiative in the next month?
- Turnaround Time: Defined as the time from when one patient leaves the operating room to the time the next patient enters. This was only measured for cases scheduled sequentially.
- Scheduling: Defined as the process used to book time in the ambulatory surgery room. This variable was used to look for changes from the way cases are currently scheduled. The operating suite Chief Nurse was asked three questions in regards to scheduling at the end of each month. These questions were known as "Scheduling Questions" (SQ). The questions were as follows: 1) Has the scheduling methodology for the Department of Surgery changed in any way during this last month? 2) Is the scheduling methodology for the ambulatory surgery room different than the rest of the operating room? 3) Do you perceive any changes in the scheduling methodology for the next month?

- RVUs: Defined as the RVUs produced per room within the Operating Room Suite.
- Waitlist Size: Defined as the number of patients on the entire Department of Surgery waitlist per month.
- Cost per RVU: Defined as the average cost associated per RVU as calculated by TAMC Resource's Management Division.
- Return on Investment: Defined as the value provided by the ambulatory surgery room in terms of PPS dollars when compared to the cost of the initiative. This was measured as a dollar amount and a percentage.
- Waitlist Time: Defined as the average number of days a patient spent waiting for their surgery once placed on the waitlist. The operating suite Chief Nurse was asked one question in regards to waitlist time. This question was referred to as "Waitlist Question" (WQ). The question was as follows: Has any preferential treatment been given to patients having surgery in the ambulatory surgical room? If the answer was yes, the chief was asked to rate the preference in terms of urgency, potential RVU count, residency requirements, or other.

Data Source

Data for this study was gathered from two sources. The Surgery Scheduler System (S3) provided the data for all variables, except total RVUs and all cost data. Developed in 1998 at Tripler Army Medical Center the system is currently managed by the U.S. Army Medical Information Technology Center (USAMITC) and has since been deployed to several other military medical

treatment facilities (MTFs) (Pope, n.d.). S3 is a web-based hospital operating room scheduling tool which manages cases from start to finish. It is designed to improve the overall operating room utilization efficiency for military hospitals. S3 pulls data from CHCS to populate patient demographics, stores default values for procedures, supplies ICD-9 and CPT codes for some procedures, as well as various other functions (USAMTIC, 2005). The S3 data is input directly by its users and requires data verification after surgery. When data is not entered it prompts providers daily for data through automatically sent e-mails until the case is closed out. From an executive standpoint the system possesses a report module that generates many different types of reports for evaluating the efficiency and productivity of the operating room. This module was used to pull data for this study.

The MHS Management Analysis and Reporting Tool (MART), also known as M2, is an ad-hoc query tool used to obtain information on population, clinical, and financial data from all MHS regions. M2 includes MTF and purchased care data integrated with eligibility and enrollment data (Health Affairs, 2005). The M2 provides data to end users to assist them in proactively managing and making decisions within their respective departments, clinics, medical activities, and medical centers. M2 pulls data from the MHS Data Repository which contains all the business data for the MHS. The M2 was used to pull RVU and cost data for the Department of Surgery both before and after the implementation of the ambulatory surgery room. Due to M2 taking approximately 45 days to update, data will be pulled monthly for the preceding month. Data was collected for the

first quarter of FY 06 as well as the first month of the second quarter of FY 06. RVU data was also compiled for individual procedures by cross referencing CPT codes with the PASBA RVU sheet.

The data for the equipment, personnel, scheduling, and waitlist time variables were self-reported by the operating suite Chief Nurse. The researcher queried the Chief Nurse at the end of each month, using the EQ and PQ, as to whether any new equipment or personnel were obtained to facilitate the ambulatory surgery room. The scheduling process data were also gathered from the Chief Nurse at the end of each month using the SQ. A limitation to this collection method is the possible recall bias of the Chief Nurse for issues that may have taken place during the beginning or middle of the month. In order to control for the aforementioned limitation, cost data for personnel and supplies were monitored for any unexplained spikes from the forecasted budget. The scheduling data were cross referenced with the finalized operating room schedule. The schedule was not the primary source because it could not explain the methods used to schedule; however, it could be used to confirm the process once explained by the Chief Nurse.

Statistics and Interpretation

Data from December 2005 and January 2006 was used to conduct Analysis of Variance (ANOVA) to determine if there was any statistical significance in the dependent variable RVU when studied against the independent variables of room and service. ANOVA was also used to study turnover time produced between the various operating rooms. An ANOVA is

used to determine inferences about group means when a study is analyzing multiple groups (Polite, 1996). ANOVA tests the null hypothesis that the group means are equal. The test works by comparing variances within the groups to variances between the groups to produce an F ratio. Assuming the group means are equal there will be no between group variability and an F of zero will be produced. However, if the group means are different there will be variability between groups causing the F statistic to increase (Polite, 1996). Assuming significance is found a post-hoc test will be conducted to identify within which group the true significance lies. A Tukey Test was the method of choice for the post-hoc test during this study.

The data for this study was entered into Statistical Package for the Social Sciences (SPSS) 11.5 to perform the ANOVA and descriptive statistics. The significance was determined by examination of the p-value. The alpha level for this test was set at .05. The alpha level corresponds to the amount of risk taken by the researcher in making a type I error. At .05 the researcher is accepting the fact that out of 100 tests, he will reject a true null hypothesis 5 times.

Validity and Reliability

Validity refers to the extent a measure is actually measuring what the researcher intends for it to measure (Cooper & Schindler, 2003). RVUs as a measure of productivity were the main objective of this analysis. Criterion validity addresses the degree to which a predictor (RVUs) is adequately capturing the relevant aspects of the criterion (productivity). This type of validity can be measured using correlation.

Prior to the introduction of RVUs into the MHS, productivity of MTFs was measured in terms of encounters. The more patients an MTF saw the more productive it was. With the move to RVUs as a measure of productivity one can question the validity of it as a measure of productivity. In order to test RVUs validity as a measure of productivity correlation between RVUs and visits was conducted.

Reliability is the degree to which a measure provides consistent results (Cooper & Schindler, 2003). Pulling data from already established MHS information systems increases reliability in that this is the same data pulled by all other executives within the MHS to make executive decisions. Cost and productivity data is entered into the respective systems by qualified well trained staff. The data is also pulled by subject matter experts determined to be completed within the Resource Management Division and Managed Care Division thereby ensuring it was done correctly. To ensure reliability of this data, a test-retest methodology was used to determine whether procedures coded by the researcher received the same value of RVUs when coded by the Coding Section at Tripler Army Medical Center. Correlation between the two sets of data was used to assess the reliability of the data statistically.

Hypothesis

H_{01}: Turnover Time (Ambulatory surgery room) = Turnover Time (rm1-12)

H_{a1}: Turnover Times between rooms are not equal

H_{02}: RVU (ambulatory surgery room) = RVU (rm1-12)

H_{a2}: RVUs for the operating rooms are not equal

H_{03}: RVUs produced by the various sub-specialty services are all equal

H_{a3}: RVUs produced by the various sub-specialties are not equal

Results

The ambulatory surgical room was originally slated to begin 1 October 2005. Due to difficulty with contracting new staff the initiative did not start until 1 December 2005. Data was collected on a daily basis for each of the operating rooms within the operating room suite for the months of December and January. The delay in data collection did not change the purpose or research question of this analysis.

Over the course of both months, 1262 surgical cases were performed in the operating room suite. Five cases were removed due to the respective service performing the case having less than or equal to two cases over the course of the month. The services consisted of Radiology, Pediatric Dental, and Obstetrics. Overall 1257 cases performed in 14 operating rooms were analyzed. For each case data were collected on what room the case was performed in, the service performing the case, whether the case was inpatient versus outpatient, if outpatient the number of RVUs received, and the turnover time if a case was scheduled immediately following.

A review of the frequencies (see Tables 3 and 4) and descriptive (see Table 5) statistics for these variables reveals 13.2% (166) of all cases were performed in room 4. This was followed by room number 13 (ambulatory surgical room) with 9.7% (122). A review of the services performing cases shows Orthopedics performed 25.5% (320) of all cases. This is over 10% more than the

next closest service. The operating suite performed 58.4% (734) of its cases as out-patient. Each of these outpatient cases averaged 8.16 RVUs per case. The 523 missing RVU cases are inpatient cases which do not generate RVUs. There where 568 cases that met the turnover time requirements. The remaining 336 missing cases did not meet requirements to be included in the analysis. The average turnover time for the two months was 38.6 minutes.

Table 3

Operating Room Use Frequency

Room Number	Frequency Used	Percent	Valid Percent	Cumulative Percent
1	51	4.1	4.1	4.1
2	73	5.8	5.8	9.9
3	68	5.4	5.4	15.3
4	166	13.2	13.2	28.5
5	109	8.7	8.7	37.2
6	96	7.6	7.6	44.8
7	108	8.6	8.6	53.4
8	82	6.5	6.5	59.9
9	111	8.8	8.8	68.7
10	76	6.0	6.0	74.8
11	92	7.3	7.3	82.1
12	81	6.4	6.4	88.5
13	122	9.7	9.7	98.2
14	22	1.8	1.8	100.0
Total	587	100.0	100.0	

Table 4

Service Operating Suite Use Frequency

Service	Frequency	Percent	Valid Percent	Cumulative Percent
Orthopedics	320	25.5	25.5	25.5
ENT	212	16.9	16.9	42.4
General Surgery	180	14.3	14.3	56.7
Gynecology	169	13.4	13.4	70.1
Urology	118	9.4	9.4	79.5
Ophthalmology	63	5.0	5.0	84.5
Plastic Surgery	38	3.0	3.0	87.5
Oral Surgery	31	2.5	2.5	90.0
Neurology	27	2.1	2.1	92.1
CT Surgery	24	1.9	1.9	94.0
Peds Surgery	22	1.8	1.8	95.8
Vascular	21	1.7	1.7	97.5
Podiatry	15	1.2	1.2	98.7
Gastroenterology	11	.9	.9	99.6
Peds GI	6	.5	.5	100.0
Total	587	100.0	100.0	

Table 5

Outpatient, RVU, & Turnover Time Descriptive Statistics

		Out vs. In patient	RVU	Turnover Time
N	Valid	1257	734	568
	Missing	0	523	689
Mean		.5839	8.164	38.63
Std. Deviation		.4931	7.745	26.04
Variance		.2432	59.99	678.21
Range		1.00	143.00	233.00

Structure

The structure portion of the analysis was measured using EQ and PQ (See Table 6 for results). Even though the initiative did not begin until 1 December 2005, the equipment and personnel questions were still posed to the operating suite Chief Nurse. With regards to equipment, the answers to question #1 "Was any new equipment over $5,000 purchased for the ambulatory surgery room?" was always "no". The answer to Question #2 "Do you perceive the need to purchase any new equipment over $5,000 to operate the ambulatory surgical room in the next month?" was always "no". At the end of December the answer was "no" with a caveat that the scheduling of similar procedures in multiple rooms at the same time may put a strain on resources, but has not to date.

Just before October 2005 a contract was awarded for the six new staff members (2- Operating Room Nurses, 2-Operating Room Technicians, 1-Certified Registered Nurse Anesthetist, and 1-Central Material Services Technician) needed to successfully operate the ambulatory surgical room. So the answer to question #1 of the PQ "Have you hired any new staff members to facilitate the ambulatory surgery room initiative?" was "yes" for the first month and "no" for the other two months. The answers for question #2 "Do you perceive the need to hire any additional staff to facilitate the ambulatory surgery room initiative in the next month?" was "no" for all three months.

Process

The process portion of the model was measured using turnover time and scheduling variables. An ANOVA was performed using turnover time as the

dependent variable and the room the case took place in as the independent variable. Five hundred and sixty-eight cases met the criteria of having another case scheduled immediately following it. All emergency cases and time and space available (TSA) cases were eliminated as well as cases not scheduled back to back. Room 13 (ambulatory surgical room) ranked sixth out of 14 with a 37.4 minute average turnover time, almost 3 minutes slower than the fastest room. The results of the ANOVA showed no significant difference with regards to what room the case was done in and its respective turnover time F (13, 554) = .485, $p > .05$. The null hypothesis is accepted.

The scheduling variable was assessed using a three question survey called SQ (see table 6 for results). With regard to question #1 "Has the scheduling methodology for the Department of Surgery changed in any way during this last month?" and #3 "Do you perceive any changes in the scheduling methodology for the next month?" the answer for all three months was no. The answer for question #2 "Is the scheduling methodology for the ambulatory surgery room different than the rest of the operating room?" was yes when answered by the operating suite Chief Nurse. Again the yes answer was with a caveat. The operating room gives services block time in each of the operating rooms to include the ambulatory surgical room. It is up to the service to schedule what cases take place in it. The services are told the methodology for the ambulatory surgery room is outpatient quick turnover cases. However, this guidance is not always followed.

Outcome

The outcome portion of the analysis used effectiveness, efficiency, and equity as the variables. The effectiveness variable was measured using RVUs and waitlist data. Overall the operating room suite produced 5,997.78 RVUs from 734 outpatient cases for the month of December. Two separate ANOVAs were conducted to look for a significant difference between RVUs and room as well as RVUs and service. In order to ensure RVUs are a valid measure of productivity, correlation was conducted between RVU and encounters for 10 surgical subspecialty clinics over 9 months of FY 2005. This resulted in an $r=.974$, $p<.000$ signifying a highly valid measure.

Data was obtained by deriving CPT codes for procedures performed in the operating room then using a Patient Administration Systems and Biostatistics Activity (PASBA) CPT to RVU converter worksheet. To ensure reliability of the researcher's coding a list of the top 20 procedures from within the operating room was submitted to the Coding Section within Tripler Army Medical Center. Correlation between the researcher's coding and two coders in the Coding Department's coding was conducted and yielded $r=.970$, $p<.000$, signifying highly reliable coding.

With regards to RVUs and the room the case is performed in, all 1257 cases performed in the operating room suite during December and January were included in the analysis. The ANOVA shows there was a significant difference between these two variables, $F(13,573) = 3.70$, $p<.000$. The null hypothesis is rejected. A post-hoc Tukey Test was conducted revealing that rooms 1, 3, and 4

all showed significance, $p<.05$, when compared against the other rooms. The ANOVA between RVUs and service performing the operations used all 1257 cases and showed a significant difference between the two variables, F (14, 1242) = 4.06, $p<.000$. The null hypothesis is rejected. The post-hoc Tukey Test revealed that Ophthalmology was significant with 11 of the 15 services, $p<.05$, for 3 services, $p<.01$, for 4 services, and $p<.000$ for 4 services. There was also a statistical significance between Otolaryngology and one other service, $p<.05$.

The analysis of waitlist was only possible for two subspecialties (Orthopedics and Otolaryngology). These are the only two sections that appear to update the number of people on their waitlist using the S3 system. Over the course of the 1st quarter Orthopedics reduced the number of people on its waitlist from 42 to 3, a 93% reduction. Otolaryngology reduced its waitlist from 40 to 7, an 83% reduction. At this time it is not possible to attribute the reduction in waitlist numbers to the addition of the ambulatory surgical room.

The efficiency variable is measured based on cost. Cost data for the operating room suite was only available for the 1st quarter of FY 2006. As a result only December data for RVUs was used in cost computations. At its inception, the ambulatory surgery room initiative was slated to cost the operating room $632,000 for one year or $158,000 per quarter. Tripler Army Medical Center does not have the ability to step down cost to individual operating rooms but rather to the operating suite as a whole. Nor does the hospital have the ability to establish a cost per case for inpatient and outpatient surgeries. Without that cost a true cost per RVU for outpatient surgery cannot be established.

Through the 1st quarter of fiscal year 2006 the operating room cost has increased $1.3 million compared to the 1st quarter of fiscal year 2005. At the same time the operating suite increased outpatient surgeries by 294 cases, and saw a decrease of inpatient surgeries by 75 cases when compared to 1st quarter fiscal year 2005. Using the average RVUs per case for the month of December 2005 (8.4) multiplied by the 294 case increase and the average fiscal year 2006 prospective payment rate for surgery of $79.50 per RVU, the total prospective payment system reimbursement for the outpatient surgery increase during the 1st quarter is $196,333.00. When compared against the cost of the initiative for one quarter, the increase has provided a 20% return on the investment with respect to outpatient surgery.

While over the course of the quarter the initiative is turning a positive return on investment, when analyzed at the room level it is not. The personnel cost for one month of service in the ambulatory surgery room is $52,666. This is the only cost that can be attributed directly to this initiative as these individuals were hired solely to work in the ambulatory surgery room. During the month of December the ambulatory surgery room produced 363.56 RVUS or $28,903 in PPS reimbursement give $79.50 per RVU. This is a 45.2% loss on the investment.

The equity variable was to be measured using the Waitlist Time Questionnaire (WQ). The questionnaire consisted of one question asking the operating suite Chief Nurse if any preferential treatment was given to patients having surgery in the ambulatory procedure room. However, after realizing that

the operating suite does not control what cases are scheduled but rather what service uses the room it was deemed by the researcher that the question could not be reliably answered. Therefore the equity variable could not be analyzed as part of this overall analysis.

Table 6

Results EQ, PQ, and SQ Surveys

		OCT	NOV	DEC
EQ				
	Q1	N	N	N
	Q2	N	N	N
PQ				
	Q1	Y	N	N
	Q2	N	N	N
SQ				
	Q1	N	N	N
	Q2	Y	Y	Y
	Q3	N	N	N

Note. January data not available.

Discussion

Past research used the Structure, Process, Outcome model to study the results of changes made to patient care, while the Effectiveness, Efficiency, and Equity model was mainly used to assess healthcare policy. By linking them together the subsequent model enabled the researcher to study the initiative from multiple levels as opposed to just the outcome. Without a doubt this model allows for a more robust analysis by researchers ensuring, for example, areas such as physical structure and internal processes are taken into account during initiative analysis and more importantly development.

Structure

The structure portion of this research is placed at the top of the model. It is the author's opinion that without proper structure (equipment and personnel) the rest of the components associated with the model will not progress with ease. In other words if the proper structure is not in place, the initiative will most likely not have the proper process and lead to a negative outcome. For this initiative the structure, in terms of personnel, was proposed as the key ingredient in obtaining higher RVUs for the Department of Surgery and specifically the operating room. Having a six person team as opposed to a three person team was to increase the efficiency of the room. An extra nurse, operating room technician, and dedicated CMS technician theoretically allows for follow on patients to be prepared for surgery while a case was still in progress. These extra personnel also were to ensure all equipment was ready for the next case and assisted in the turnover of the room.

It can be assumed that when the contractor could not fill all six positions by the 1 October 2005 execution date, the initiative would not function as intended. By the end of November the operating room made a decision to implement the initiative with four of the six personnel. They augmented the two operating room nurses from their own staff pool. As of the end of December the two operating room nursing positions had still not been filled.

The time line given by the Surgeon General's Office to develop initiatives was very limited but cannot be used as an excuse for lack of proper market research by the initiative developer. While it is customary that the contractor

performs market research as to whether potential candidates are available to fill the positions, the initiative developer should take it on their shoulder to ensure their proposal has merit. Especially since Tripler is located in the most isolated chain of islands in the world and there is a known lack of certain medical skill sets on the islands.

The other element of structure assessed by this initiative was equipment. Prior to the implementation of the initiative, equipment was not necessarily an issue within the operating room. Even with the implementation of the initiative the need for new equipment was not an issue. However, on certain days some sub-specialties could and would be operating in three or more rooms. Failure to schedule appropriately can result in the same piece of equipment being needed in multiple rooms at the same time. The most common example is an operating room table extension for shoulder surgery. Tripler only possesses two of these extensions. It is not uncommon for Orthopedics to operate in two or more rooms at the same time. For example, over the months of December and January, Orthopedics performed surgeries in multiple rooms 34 out of 44 scheduled days. If not careful more than two shoulder surgeries can be scheduled at the same time resulting in lost time, and reduced productivity.

One area not measured in this analysis but deserving of further comment is the physical structure of the operating room. Tripler has 12 physical operating rooms in the operating room suite. For this initiative the ambulatory surgery room was a fictitious 13th room which floated between the 12 rooms. For example, one day the ambulatory surgery room may be room 6 and the next day

room 8. It is this researcher's opinion that further research is needed on similar rooms and whether a floating room is more productive than a stationary room that does not change. It is an assumption that a stationary room could be stocked with necessary equipment specific to high volume quick turnover cases, whereas a floating room cannot.

Process

One of the premises behind an ambulatory surgery room is the room should perform more cases a day than a normal room. The Tripler ambulatory surgery room averaged 3.13 cases a day over the two months, which is the same number of cases the Brooke Army Medical Center (BAMC) Orthopedic Ambulatory Surgery Room averaged over its 1st quarter. However, when compared to the other operating rooms within Tripler this is only .07 cases more than the next highest room and .5 cases more than the average for the entire operating room over the two month period. Scheduling methodology and turnover time are two areas that need to be addressed to make the process work more smoothly and ultimately increase utilization and productivity of the room.

An analysis of what services produce the most RVUs while using the least amount of minutes of service would show which services should have the most time in the ambulatory surgery room, assuming that service's case load is large enough to occupy the room. Ophthalmology is the service that produces the most RVUs per case at Tripler while Orthopedics, which is believed to be the highest producer by administrators outside the operating room, is seventh. Ophthalmology used 16.39% of the total minutes of service recorded for the

ambulatory surgery room. Orthopedics coupled with two other services used over 63.9% of the total minutes of service. This type of information would improve the scheduling process. However, Tripler is a military hospital and its primary mission is the readiness of the active duty soldier; the need for orthopedic services is much higher than that of ophthalmology.

These issues show the leadership challenge involved in scheduling services and cases. In order for this initiative to be successful there must be buy-in and endorsement from the senior leaders in the Department of Surgery. Continuing to schedule the way they always have will not improve the outcome. A change must be made and enforced on what service and what types of procedures are performed in the ambulatory surgery room.

Turnover time is another area that if improved can yield more available room for additional cases. The ambulatory surgery room was 3 minutes slower than the fastest room in the operating room suite. Assuming proper structure, there is no reason if it is performing short procedures why it should not be first. Compared to BAMC's room, which has a repetitive schedule and a fixed staff, the Tripler room is just under 8 minutes slower in turnover time per case. Improving turnover time could lead to 1 extra case a day or 21 cases a month given the Medical Command standard of approximately 21 work days a month. This could yield 252 extra cases a year. Averaging 8.6 RVUs per case those 252 extra cases would equal 2167.4 extra RVUs over the course of the year, which is equivalent to $172,292.40 in prospective payment reimbursement given the FY 2006 prospective payment rate of $79.50 per RVU.

Outcome

While it does appear that the Department of Surgery did produce more RVUs as compared to December FY 2005, these RVUs cannot be attributed to the ambulatory surgery room. As explained to this researcher by the operating suite Chief Nurse, operating rooms traditionally measure their productivity in terms of minutes of service. Minutes of service can be linked to all different types of procedures with similar RVUs. However, RVUs do not go to the operating suite. They go to the service performing the surgery. Therefore measuring the productivity of an operating room based on RVUs is not necessarily the best method. One month of a reduced acuity in patients will reduce the amount of RVUs produced but does not mean the operating room has been less productive. Further research is needed on developing a system which will establish a standard for how many minutes of service a certain procedure should take under normal conditions. Operating room staff and providers could then be measured against this standard for addressing productivity within the walls of the operating room suite. Once established this standard could be used to examine RVUs by minutes of service for similar procedures. Providers could be profiled by how many RVUs they produce per minute in the operating room for various procedures. While there are still potential confounders which could increase the total minutes of service this would be a more accurate way of looking at operating room productivity.

With respect to efficiency the results show what appears to be a 20% return on investment across the quarter when compared to the total operating

room outpatient workload. However, a 45.2% loss is noticed over the course of December when just the ambulatory surgery room is analyzed. The positive return on investment cannot be attributed directly to the outpatient surgery initiative, as the ambulatory surgery room is not the only room performing outpatient surgery. A more accurate depiction of efficiency is shown by examining only the cost associated with the ambulatory surgery room. Due to the limitations with assessing cost in the operating room this method is also limited because it only takes into account the additional contract personnel cost.

More concerning to this researcher is the decrease in inpatient cases. The PPS reimbursement for inpatient services is $7,293.29 per RWP. This is important in that the basis of the jumpstart initiatives was an increase in RWPs or RVUs. An examination of the operating room's budget would reveal that a majority of it is in "sunk costs." Regardless of what types of procedures are performed the cost of personnel, utilities, and administrative supplies will remain approximately the same and have to be paid. The only area of truly variable costs is in medical supplies. By increasing RWPs the operating room would be able to show a bigger return on investment. Figure 4 demonstrates the affect of increasing inpatient workload by 10 and 20% based on the December workload while decreasing outpatient workload by the same amount at the same time. A decrease in 20% outpatient cases results in a loss of $46,746 with respect to PPS reimbursement. A simultaneous increase in inpatient procedures, assuming one RWP per case, would reveal an increase $670,983 in PPS reimbursement, a net increase of $624,237.

Conclusion

Based on this analysis the author concludes that an ambulatory surgery room does not produce a more significant amount of RVUs as compared to the other rooms in the suite. The author does acknowledge that more research is needed as two months worth of data limits the analysis. More importantly an analysis of the process by which initiatives are developed is needed. The process starting from the time a patient enters the hospital for surgery, through the surgery and subsequent discharge or movement to a ward involves approximately 12 steps (Figure 5) of which six are rate limiting steps. The initiative got off to a poor start by only addressing personnel to operate the ambulatory surgery room without looking at the effects the initiative will have on the other steps.

Lack of market research as to whether the positions could be filled also had a negative effect on the initiative. A broader approach should have been taken in the development of the initiative and addressed whether the surgical sub-specialties could balance another day in the operating room against work performed in the outpatient clinics. Furthermore the effects of having the same sub-specialty operating in two to three different rooms at the same time on equipment and supplies needed to be addressed to figure out what could and could not be accomplished. Lastly, operating rooms use minutes of service to measure their productivity. Using RVUs is difficult as they are attributed to the service performing the surgery and not the operating room suite. Research is needed on how to link minutes of service, RVUs, and the service that is

producing them. While this would be a massive undertaking, a hospital could look at the top 5-10 surgeries and gather baseline data on how long it takes for the respective specialty physicians to complete them. Once an adequate baseline is developed an average minutes of service for a given procedure could be established. Once established a surgeon who takes longer than the average, given a similar case would not be producing the same RVUs per minute of service as the other providers in their same specialty. Nonetheless, this initiative should act as a lesson that while obtaining venture capital funds may become easier, it does not eliminate the need or responsibility of leaders to produce a sound analysis for which to request funds.

Recommendations

Based on the results of the study this author recommends a twofold course of action be taken by Tripler Army Medical Center. The process by which venture capital funds are requested needs to include a mechanism to ensure that an entire process is analyzed and not just a segment of a process. By only analyzing and implementing change on a segment of the process the results could throw the entire process out of balance. The mechanism needs to ensure that when making changes to a segment the rest of the process will be able to absorb the change. Furthermore this process cannot be rushed and data must be available to support the idea and have key leadership backing.

With regards to the ambulatory surgery room initiative, the author recommends a study looking at how to link RVUs to minutes of service. A potential project could involve the profiling of surgeons by specialty and case

type. By looking at the time it takes surgeons to complete similar cases a base line could be established and used as a benchmark. For example a profile on general surgeons performing hernia repair could be established. After a thorough study has been conducted a benchmark for the minutes of service it should take to complete a routine hernia repair would be established. Hernia repairs receive the same number of RVUs regardless of the time it takes to perform the surgery. A surgeon not performing at or near the established benchmark would not be earning the same number of RVUs per minutes of service, therefore could be labeled less productive.

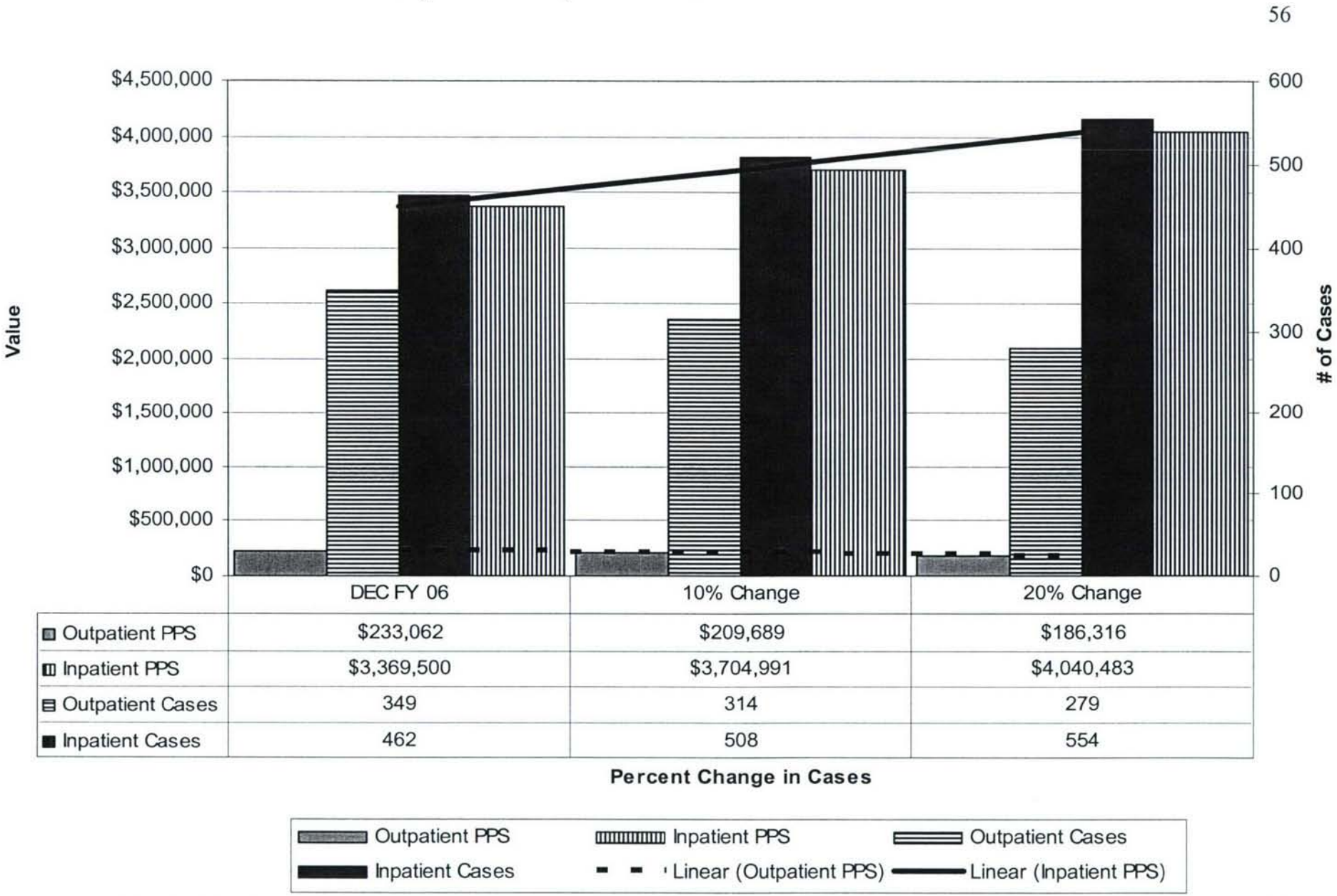

Figure 4. . Number of cases and PPS reimbursement projections given a 10% and 20% decrease in outpatient cases and a simultaneous increase in inpatient cases

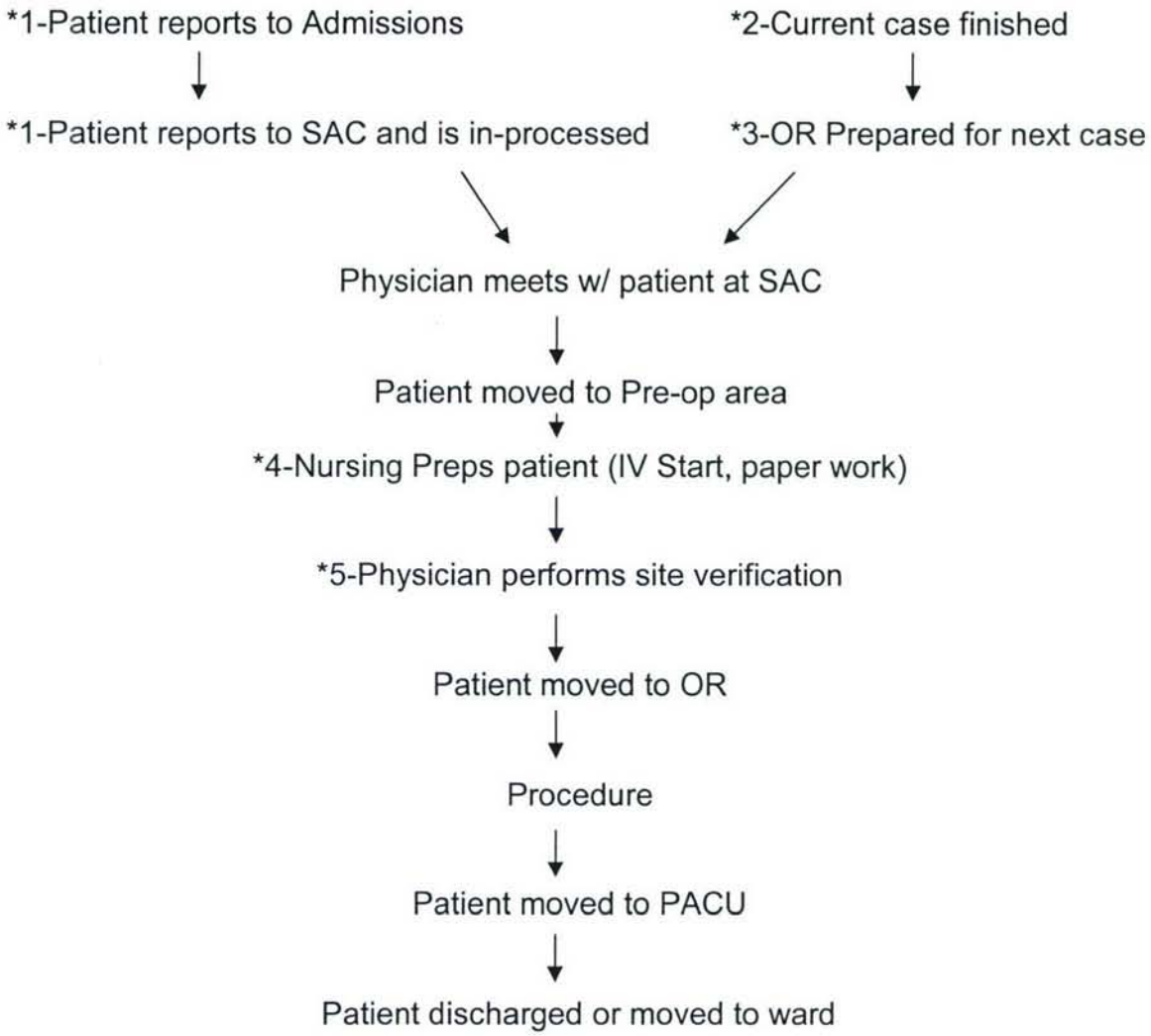

Figure 5. Operating Room Patient Flow

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* Signifies rate limiting steps in the process. Failure at one of these points can result in loss of productivity and efficiency.

*1- If patients report late to admissions or the SAC cases may be delayed

*2- If a cases goes longer than expected do to a physician miss calculating the length of a procedure cases can be delayed.

*3-If staff is not available to turnover the room the next case can be delayed

*4-If nursing staff is not available to prep the patient the case can be delayed

*5-If physician does not meet with the patient in a timely manner the case will be delayed

Appendix A – Sample Buck Slip

Staff Surg: [redacted] **Primary Surg:** [redacted]

Procedure: OPCAB
Est. Time: 04:00 **Case Card:** 0610 OFF PUMP HEART
Diagnosis: ASCAD **CPT(s):** **ICD9:** NULL

Special Instructions: Please place in room 1

Anesthesia MD: [redacted] **CRNA:** **SRNA:**

☐ ASA 1	☐ ASA 3	☐ ASA 5	☐ Art Line ☐ CVP ☐ PAC
☐ ASA 2	☐ ASA 4	☐ E	

☒ General	☐ Gen+Periph Reg(planned)	☐ Intrathecal Narcotics	☐ Local IV Sed
☐ Epidural	☐ Gen+Periph Reg(unplanned)	☐ Combined Spinal/Epidural	☐ Local/MAC
☐ Gen+Epidural	☐ Spinal	☐ Regional	☐ None
☐ Gen + Epid (unplanned)	☐ Gen + spinal (unplanned)	☐ IV Regional (Bier)	☐ Fentanyl PCA

Anes Start	In Room	TOTS	Cut	Close	Out Room	Anes End

Nurse Scrub: [redacted] **Circulator:** [redacted] **Monitor:** **Observer:**

Sepsis: ☐ 1 ☐ 2 ☐ 3 ☐ 4 Nurse Start: Nurse End:
Lab Specimen:
Drains:
Implants:

Figure Caption

Figure 1. Starfield model showing the relationship between structure, process, outcome, and environment.

Figure 2. Aday, et al. (1999). model showing how effectiveness, efficiency, and equity fit into the structure, process, and outcome model.

Figure 3. Ambulatory surgical room research model.

Figure 4. Number of cases and PPS reimbursement projections given a 10% and 20% decrease in outpatient cases and a simultaneous increase in inpatient cases

Figure 5. Operating Room Patient Flow

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